4. Resources

Introduction

The FAA possesses significant internal capability for managing and conducting aviation-related research and development programs. The bulk of this capability is located at the William J. Hughes Technical Center (located at the Atlantic City International Airport, Atlantic City, New Jersey) and the Civil Aerospace Medicine Institute (located at the FAA Mike Monroney Center, Oklahoma City, Oklahoma). The balance of the agency's internal capability is resident with the staff of the FAA Headquarters' organizations (Washington, D.C.) and at the FAA Air Traffic Control System Command Center (Herndon, Virginia). All of these organizations are staffed by dedicated researchers, engineers, software developers, analysts, and other specialists, skilled in their disciplines and highly experienced in aviation technology and operations. They are the critical resource essential in the development, effective management, and performance of agency research and development.

The FAA's research workforce provides the required capabilities to:

- Conduct Internal R&D
- Conduct External R&D
  - Provide oversight and review, as appropriate, of our partners' research efforts, including:
    - Contract or grant management
    - Technical performance
    - Deliverable acceptance on behalf of the government
- Manage the R&D Program
  - Program management
  - Technical management
  - Program planning and budgeting
  - Communication and dissemination of program goals, plans, progress, and research results among all parties

The FAA also relies heavily on the work of R&D partners to provide the skills and capabilities necessary to perform all the research and associated activities necessary to support the FAA's mission. These partners, coming from industry, academia, and other government organizations, augment internal capabilities and supply needed capabilities outside of agency core needs.

External Partnerships

NASA

Safety

In August 2000, NASA and the FAA signed the first *FAA-NASA Integrated Safety Research*

Plan,[10] which builds on existing FAA-NASA relationships to assure ongoing communication and coordination of safety research and establish a strategy for the two agencies to make complementary, coordinated research investment decisions. That plan includes the FAA-NASA Safety Investment Strategy, which has four objectives: coordinate strategic assessments and investment portfolios; synchronize communication opportunities based on individual agency budget cycles; integrate implementation plans; and assess work in progress. NASA's role in aviation safety research is the development of enabling tools and technology, with implementation to occur through industry actions as well as incorporation into FAA operational programs and requirements.

Efficiency

The FAA/NASA Interagency Air Traffic Management (ATM) Integrated Product Team (IAIPT) coordinates research directed toward air traffic control technologies and the development of procedures for their safe and efficient use.[11] The IAIPT is comprised of the major stakeholders in the planning, execution, and outcome of ATM R&D programs, throughout the FAA and NASA. Its work teams execute research activities in six areas:

- *System/Cross-Cutting*: System-wide initiatives, including the initial definition of concepts and use of human factors and modeling assessment methodologies and demonstrations.
- *Traffic Flow Management*: Strategic resource allocation and flow management.
- *Surface*: Operations on an airport's surface.
- *Terminal*: Operations in airspace surrounding one or more closely spaced airports where a TRACON or a comparable military facility provides services.
- *En route*: Operations in airspace between airports where an Air Route Traffic Control Center (ARTCC) provides services and transition airspace between the en route and terminal environments.
- *Oceanic*: Operations in airspace over international waters where an oceanic ARTCC provides services.

The IAIPT also maintains collaborative partnerships with Federally-Funded Research and Development Centers, industry, academia, Department of Defense, EUROCONTROL, the Center of Excellence in Operations Research, and the National Weather Service. IAIPT research is accomplished at the following research facilities: FAA William J. Hughes Technical Center,

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[10] *FAA-NASA Integrated Safety Research Plan,* prepared in March 2000 and periodically updated.

[11] *Integrated Plan for Air Traffic Management Research and Technology Development*, Jan. 2000.

NASA Ames Research Center, NASA Langley Research Center, MITRE Center for Advanced Aviation System Development (CAASD), Massachusetts Institute of Technology (MIT) Lincoln Laboratory, Volpe National Transportation Systems Center, and NASA North Texas Research Station.

The FAA/NASA Joint University Program

The FAA/NASA Joint University Program for Air Transportation Research (JUP) is a long-term cooperative research partnership among three universities to conduct scientific and engineering research. The JUP provides grants to Massachusetts Institute of Technology, Ohio University, and Princeton University to support research covering a broad range of relevant technical disciplines that includes human factors, satellite navigation and communications, aircraft flight dynamics, avionics, and meteorological hazards. The universities gain informed comment on their research, as well as proposed new avenues for investigation, via periodic reviews and interactions with FAA and NASA aviation and technical experts. Through this program, NASA and the FAA leverage their resources, enabling them to achieve better high-priority goals. They benefit directly from the results of specific research projects, and, less formally, from valuable feedback from university researchers regarding the goals and effectiveness of government programs. An additional benefit is the creation of a talented cadre of engineers and scientists who will form a core of advanced aeronautical expertise in industry, academia, and Government.

Current JUP research topics include:

- Runway operations planning and control;
- Investigation of information requirements in the future NAS information architecture;
- Modeling of human performance of runway incursions;
- Voice recognition for controller/pilot data link communications;
- GPS-related application issues and technologies;
- Flight control systems;
- Intelligent aircraft/airspace system; and
- Coordinated flight of uninhabited air vehicles.

Center for Advanced Aviation System Development (CAASD)

CAASD, an operating center of the not-for-profit MITRE Corporation, is a federally funded research and development center sponsored by the FAA to perform essential research and development in the area of air traffic control and management. It serves as an essential component of the FAA research program, providing in-depth operational knowledge and technical sophistication, extensive capability in aviation-related technologies, and laboratory systems that support system development. CAASD's work for FAA focuses on high-level

system architectures and CNS/ATM research and development, particularly in the areas of navigation and surveillance and traffic flow management.

Technology Sharing, Transfer, and Cooperative Agreements

Technology transfer activities enhance the resource base for performance of FAA R&D by addressing the need for government-private sector cooperation by enabling companies, institutions of learning, and federal laboratories to work together to develop innovative technologies and marketable products.

Cooperative Research Development Agreements (CRDAs) have proven highly effective in facilitating technology transfer. The CRDA allows the FAA to share facilities, equipment, services, and personnel resources in cooperation with private industry, academia, or state/local government agencies. It is implemented to develop an idea, prototype, process, or product for direct application to the civil aviation community and/or indirect application for commercial exploitation. The FAA has made extensive use of this mechanism over many years to foster advances in all of its mission goal areas. The breadth and relevance of CRDAs is illustrated by a sampling of recent and current examples:

- Maintenance, inspection, and structural design and integrity of aging aircraft;
- Damage prediction models for aircraft hardening against explosions;
- Collision avoidance warning systems;
- Detection systems for weapons and explosives;
- Advanced weather information systems with graphical display products;
- Means of detecting and predicting the presence of ice on aircraft surfaces;
- Soft ground arresting system to safely stop aircraft that overrun the available length of runway;
- Measurement of in-flight thrust of gas turbine engines;
- Use of GPS technology to generate an acceptable Local Area Augmentation System that will meet Category III precision approach requirements;
- National Airport Pavement Test Machine airport pavement technology; and
- New oxygen mask/regulator technology.

Another facet of technology sharing is FAA's participation in the Small Business Innovation Research (SBIR) program, which seeks to use small business as effectively as possible in meeting federal research and development objectives, and to contribute to the commercialization

of innovative ideas. Small contracts are awarded on the basis of responses defining areas of specific interest to FAA and other DOT agencies. After small business contractors complete the second phase of the SBIR cycle, they can often participate in CRADA's with the FAA to facilitate successful commercialization of their research products.

Air Transportation Centers of Excellence

Air Transportation Centers of Excellence are established through cooperative agreements among academic institutions and the FAA to assist in mission-critical research and technology areas. After 10 years of FAA funding, they are expected to be self-supporting. FAA research organization staff work closely with the Centers of Excellence in shaping the R&D, incorporating results into FAA programs, and disseminating findings. Currently there are four Centers:

- Airworthiness Assurance: 28 university members--working with more than 100 academic, industry, and government institutions--conduct research in the major areas of:
  - Maintenance, inspection and repair;
  - Crashworthiness;
  - Propulsion and fuel systems performance and safety; and
  - Advanced materials.
  - Operations Research: This team[12], which includes ten university affiliates and twenty industrial partners, focuses on:
    - Traffic management and control;
    - Human factors;
    - System performance and assessment measures;
    - Safety data analysis;
    - Scheduling;
    - Workload management and distribution;
    - Navigation;
    - Communications;
    - Data collection and distribution; and
    - Aviation economics.
- Airport Pavement Research: This Center, established at the University of Illinois (Urbana-Champaign) and supported by Northwestern University, focuses on new technologies to handle the high pavement loads of the largest current aircraft and those anticipated in the future. The research includes rehabilitation and non-destructive testing and evaluation of existing pavement.

[12] The team is led by University of California (Berkeley), Massachusetts Institute of Technology, Virginia Polytechnical Institute, and the University of Maryland (College Park)

- General Aviation: This Center,[13] established in 2001, is developing synergistic relationships among academia, industry, and government. It is significantly enhancing opportunities for innovation in general aviation research.

R&D Funding

The first and foremost resource for R&D is the budget authority provided by the Congress. This authority provides the financial wherewithal to sustain the internal R&D staff and facilities and to procure the goods and services necessary to augment internal efforts in achieving R&D goals.

Funding for FAA research programs is provided by the Congress in three different appropriations: the Research, Engineering and Development (R,E&D) appropriation, the Facilities and Equipment (F&E) Appropriation, and the Operations (Ops) Appropriation. In FY 2001, the R,E&D appropriation accounted for two-thirds of R&D funding with substantially all of the balance coming from the F&E Appropriation. The Ops Appropriations, used for a small R&D program supporting Commercial Space Transportation regulatory issues, provided substantially less than one percent of the total.

From a historic high in FY 1995, there was a significant drop in appropriated R&D funding in FY 1996. The budget remained relatively stagnant until FY 2001. Adjusted for inflation (current year dollars), current funding still lags behind that high in terms of purchasing power. (Figure 4-1)

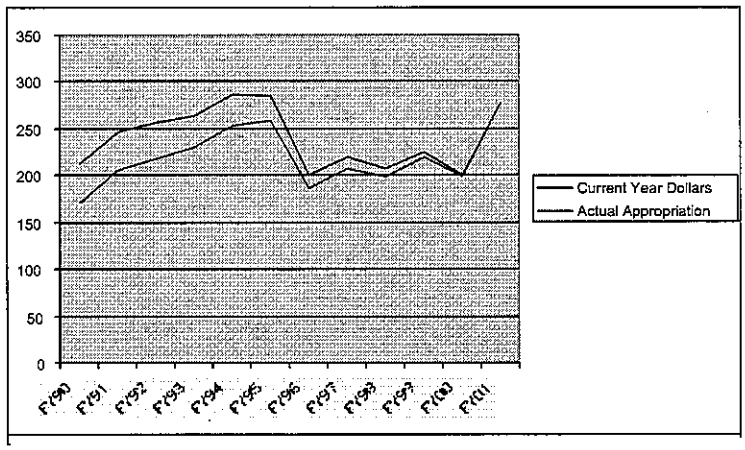

Figure 4-1. Total FAA R&D Funding ($M)

All R&D was funded through the R,E&D Appropriation through FY 1998. Beginning in FY 1999, the Congress moved a substantial portion of the funding for Air Traffic Management R&D and all of the Airport Technology R&D to the F&E Appropriation (Figure 4-2). The F&E funding was provided in two separate budget line items, Advanced Technology Development and Prototyping and Safe Flight 21.

With one exception, the projections for funding shown in Figure 4-2 are based upon OMB planning figures through FY 2006 and 3 percent growth for the following years. The exception is the Safe Flight 21 Program, a technology integration demonstration, which is funded only through FY 2007. All projections shown are planning figures derived for the purpose of developing the research strategies. *They are not commitments by either the Department of Transportation or the Congress to specific funding levels and, hence, are subject to change.*

[13] Members include Embry-Riddle Aeronautical University, Wichita State University, University of North Dakota, Florida A&M University, and the University of Alaska.

There is also an active R&D program for commercial space transportation, which has been budgeted at a relatively modest level of $100,000 per year and funded through the Operations Appropriation. These amounts are not depicted in Figure 4-2.

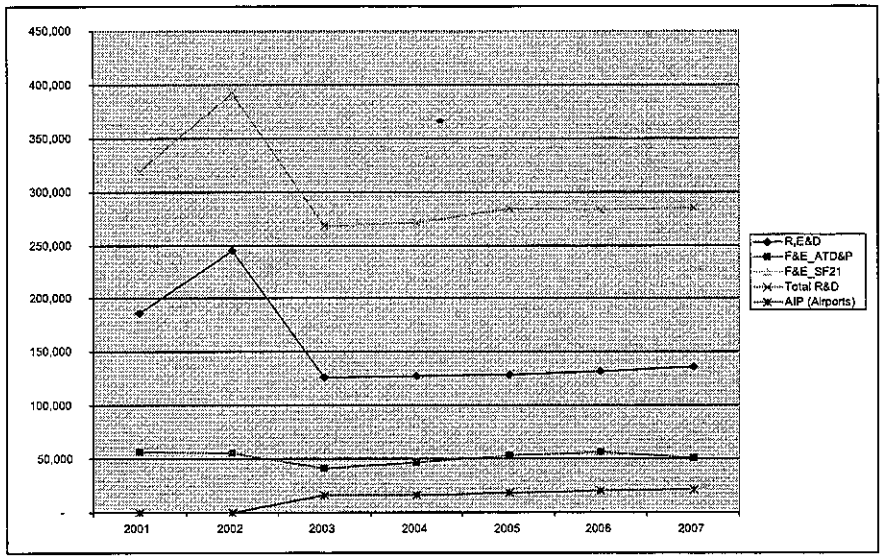

Figure 4-2. Funding Outlook by Appropriation ($K)

Taken alone, absolute funding levels show only a partial view of FAA R&D funding resources. Figure 4-3 offers an alternative presentation, based on the goal-oriented structure of the R&D Strategy. It indicates how the funding was distributed in fiscal years 2001 and 2002 across the mission and enabling goals of the FAA Strategic Plan. (As noted previously, funding assigned to a specific goal also may be supportive of one or more of the other goals; the assignment is based on the primary affected goal.)

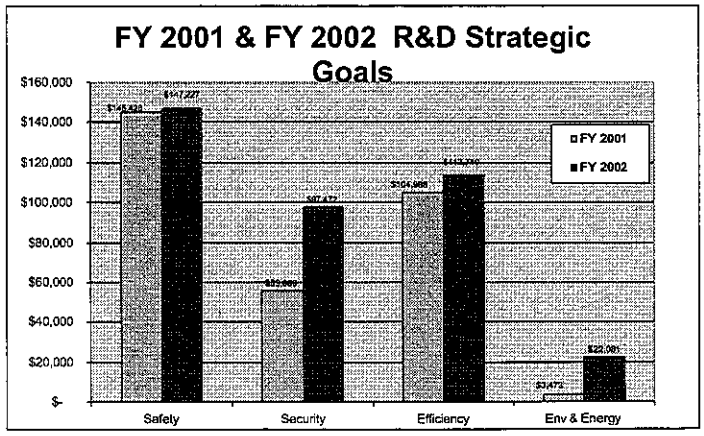

Figure 4-3. Funding by Strategic Goal ($K)